A long-term view of Australian agriculture: history, future and lessons

Michael Dunlop[1] and Graham Turner[2]

[1] CSIRO Sustainable Ecosystems, GPO Box 284 Canberra, ACT 2601. www.cse.csiro.au Email michael.dunlop@csiro.au
[2] CSIRO Sustainable Ecosystems, GPO Box 284 Canberra, ACT 2601. www.cse.csiro.au Email graham.turner@csiro.au

Abstract

This paper describes three very different scenarios for the future of agriculture in Australia. Each scenario has a mixture of social, economic and environmental benefits and costs. The scenarios serve to challenge preconceptions about the future and focus attention on long-term sustainability of agriculture. A range of lessons for the future development of Australian agriculture are drawn from the scenarios and discussed.

Media summary

Future issues for the long-term sustainability of Australian agriculture are drawn from examining developments over the last 150 years and exploring three 50-year future scenarios.

Key Words

Australian agriculture, natural resources, sustainability, long-term futures.

Introduction

One hundred years ago Australian landscapes were very different from how they are today. Over the coming century there will almost certainly be equally as dramatic changes. Past agricultural developments brought profit to many, sustained vibrant rural communities and contributed significantly to national economic growth. However, they also saw increasing clearing of land and extraction of water for agriculture, resulting in negative impacts on land resources, river health, biodiversity, rural infrastructure and other sectors of the economy. No-one can predict exactly what changes there will be in the future, but it is possible to explore what the future might be like, and ask what issues need to be addressed to ensure long-term sustainability.

In a recent project we set out to address these issues with a national and multi-generational perspective. The project used a combination of traditional scenario planning methods and analytical simulation modelling using the Australian Stocks and Flows Framework (ASFF, CSIRO's national model of the economy in physical terms) to develop and explore three very different scenarios for the future development and management of land and water in Australia. The scenarios are deliberately broad and long-term (50-100 years) in scope – there can be no other scope for a debate on sustainability. The scenarios encompass the whole of the Australian landscape, but their descriptions focus on agriculture as the dominant user of natural resources. Each scenario can be viewed as a different "solution" to the problem of balancing a range of economic, social and environmental values. The scenarios are not presented as forecasts, rather their purpose is to challenge preconceptions and stimulate discussion about what the future could be like, to focus attention on issues affecting long-term sustainability, and to provide a platform for testing specific strategies or policies.

The paper presents brief descriptions of the development of the scenarios, the scenarios themselves and some implications that can be drawn from them. Details of the analytical results are available in Dunlop et al. (2002) and Dunlop et al. (2004).

Methods

The scenarios describe a sample of physically feasible futures driven by global developments, aspirations for Australia's landscapes and technological developments. They were developed by:

- examining changes in agriculture associated with the last 140 years, current trends and near-term forecasts;
- analysing the factors that drive change over the scale of human generations (not El Ni?os, or business cycles), including past, present and emerging drivers such as, global trends, technological developments, biophysical realities, consumer preferences, community expectations, energy futures and regional development;
- constructing three story lines for the future based on those drivers; and
- developing these in the ASFF (Dunlop et al. 2002).

Scenario development combined elements of traditional scenario planning (as pioneered by Royal Dutch Shell Corporation) and simulation modelling using the ASFF, and is a major advance over trend analysis and statistical extrapolation. The ASFF is a system for conducting integrated physical analyses of the Australian economy. Development of the scenarios in the analytical framework ensures they are physically feasible, internally consistent and, at least initially, consistent with contemporary trends. ASFF scenarios are grounded on a 140 year quantitative history period. Many aspects of the future are dominated by irreducible uncertainty, hence the scenarios are plausible futures, not predictions of what is most likely to happen. Lessons for the future of Australian agriculture were drawn from all aspects of developing the scenarios and from exploring the implications of them from various sectoral perspectives.

Three long-term scenarios

Each of the three scenarios reflects a different balance between a wide range of values and outcomes for Australian agriculture, the environment and society. The scenarios are markedly different from each other and from the present, but the changes are spread over 50 years with most rates of change no faster than those that have been experienced at some time in the past. Quantitative descriptions of the scenarios are included in Dunlop et al. (2002) and Dunlop et al. (2004).

Water, water everywhere: dryland agriculture scenario

In this scenario, rainfall is recognised as a vast resource for dryland agriculture that is largely wasted due to poor water use efficiency of crops and pastures. Dryland cropping systems are adapted to increase water use, leading to increases in yields (and productivity) and decreases in deep drainage, nutrient leaching and loss of topsoil. In southern Australia the more marginal land not capable of supporting productive crops and pasture is retired from intensive use, revegetated with woody vegetation to varying degrees and used for extensive grazing, conservation and agroforestry. In northern Australia, development over the next 50 years of 9 Mha of intensive agriculture, consisting mainly of sown pasture but including cereals and other feed crops, supports an expanding beef industry. This increase in area approximately balances the reductions in southern Australia.

Accelerating declines in water quality and river health in the early years of this scenario dramatically highlight to the broader community the plight of Australia's waterways. Due to growing demand and commitment to increasing waterway health, the total area irrigated falls substantially in our analyses. This is accompanied by a shift to higher value products. Most of the reduction is in irrigated pasture and rice, but the areas of irrigated cereals, cotton and sugarcane also fall. Irrigated horticulture more than doubles by 2051. There is minimal expansion of irrigation in northern Australia beyond the Ord River II irrigation development.

The quantitative implementation of this scenario shows that a total of 6600 GL less water is used for irrigation as a result of moderate increases in water use efficiency over the scenario, combined with the reductions in the area irrigated, especially in southern Australia. Most of the water saved is allocated to environmental flows, while a portion is diverted to supplement water supplies in southern cities, allowing increased environmental flows in their supply catchments.

Increased crop water use efficiency, use of soil ameliorants and new rotations contribute to significant slowing of soil acidification and structural decline. Factoring together all the concurrent changes, we find the reduced area of irrigation and application rates substantially decrease rates of irrigation salinity. Expansion of dryland salinity is reduced moderately by increases in water use efficiency, however it remains a significant issue in many regions. In some catchments, including the Murray-Darling Basin, increased environmental flows help reduce salinity concentrations through dilution.

Give and take: irrigation scenario

In this scenario, further development of irrigation allows continued growth in the value of agricultural production while substantially reducing the total area used for crops and sown pastures. Irrigation infrastructure in southern Australia is renovated, thus increasing water use efficiency. In addition, there is considerable transfer of water from high water use/low value activities (pasture and rice) to lower water use/higher value crops (horticulture). In our analyses these efficiency gains allow 40% increases in the area irrigated in southern Australia by 2051 and re-allocation of 800 GL of water to the environment. In northern Australia, 1.25 Mha of irrigation is developed for cotton, sugarcane, horticulture and other crops. At this level, diversions in northern Australia remain well within estimated sustainable limits (NLWRA 2001).

The area of dryland crops and pastures is decreased by 40% by 2051, with retired land being substantially revegetated with woody plants and used for various purposes including production and conservation. This retirement of less productive cropland contributes significantly to increases in average yields and maintenance of productivity gains. Revegetation of substantial cleared areas significantly reduces further expansion of dryland salinity. Pasture phases in rotations are increased thus helping to improve soil structure and fertility, and moderate increases in the use of lime see some reductions in soil acidification. Due to better management of irrigation, the rate of irrigation salinity in existing and new irrigation areas declines, although many southern rivers remains stressed.

Brave new regions: post-agriculture scenario

In this scenario, dryland and irrigated agriculture both contract substantially in area and importance in most regions. Farming systems are redesigned to minimise loss of landscape function while maintaining productivity. This includes development of perennial crops and increases in pasture and non-cereal crops in rotations. Overall there are substantial reductions in irrigation, however the area of irrigated horticulture increases markedly during the scenario. Our analyses demonstrate significant reductions in water use in both southern and northern Australia, with 8700 GL returned to the environment. Land transferred out of sown pasture and crop production is largely revegetated with perennial vegetation and used for extensive grazing, forestry (including energy crops), conservation and other non-extractive uses. There are substantial reductions in the impact of agriculture on landscape function.

A key component of this scenario is the development of new regional industries. These include: industries that add value to traditional agricultural products and to new industrial and pharmaceutical products; service industries supporting the redesign of farming systems; and non-agricultural industries that are attracted by high-amenity, low-cost work environments.

Implications for the future development of Australian agriculture

Continuing the trend?

Over the last 140 years the area of land used for growing crops and sown pastures in Australia has expanded exponentially, averaging 2% per year, or doubling every 35 years (Dunlop et al. 2002). This past rate of increase is unlikely to continue into the future. First, constraints on the availability of land resources make it physically improbable. In the regions already used for agriculture there is simply not enough arable land to keep increasing the area of crops and improved pastures. Where there is scope for expansion, widespread land clearing required to develop significant areas of new arable lands would face

strong resistance. Similarly, in most irrigation areas there is no scope for substantially increasing the volume of water used. There are significant areas, mainly in northern Australia, where potentially arable land and water resources have not been exploited, but this has not been for lack of trying. Considerable research and investment would be required to successfully develop these resources. Even then, it is unlikely that the area that could be developed would be sufficient to continue the historic rate of growth in land use for more than a decade or so. Second, as the negative impacts on the health of land, water and ecosystem resources are better understood they are increasingly being judged as unacceptable (Williams and Saunders 2003). To sustain growth, future rain-fed and irrigated farming systems must look toward increasing the efficiency of resource use, especially in higher rainfall areas where there are significant gains in water use efficiency to be made.

Future degradation

How important has this steady increase been for the past performance of agriculture in Australia and what might be the consequences of it not continuing? Throughout most of the history of cropping in Australia, one-third of the land in cultivation has been less than 20 years old, and half has been less than 35-40 years old. This means that additions of new land would have reduced the net impacts of any yield losses that occurred as a result of gradual land degradation. This suggests that degradation will have a greater impact on productivity growth in the future than it has to date. Furthermore, due to the delay in the appearance of many forms of degradation, future land degradation may be far greater than current trends would suggest, as these trends are the result of agricultural activity decades ago, not the much greater current levels of activity. Farming systems of the future must place much greater emphasis on maintaining and restoring the resource base.

Future change is inevitable

The history of agriculture in Australia is marked by constant change. Change has resulted from the actions of governments, development of new markets and breakthroughs in technology. There will continue to be changes in the future. The three scenarios incorporated gradual transitions from current trends and relatively small annual rates of change, yet over a 50 year period they represented landscapes that are considerably different from the present. One of the keys to successfully delivering future sustainability is likely to be accepting that structural change is inevitable, then seeking strategies that capitalise on the opportunities and minimise the costs while ensuring benefits and costs are shared across the whole community and across generations. Such strategies would require substantial investment, national coordination and involvement of the whole community. The alternative is strategies that seek to resist change or minimise its short-term costs, but lead to lost opportunities, adverse long-term impacts and significant clean-up bills for future generations.

The disjunction between agriculture and the environment

Many, but not all, environmental problems result directly from agricultural practice, yet they have relatively little direct negative impact on agricultural production (e.g. dryland salinity, widespread loss of native vegetation). Addressing these issues at their cause would, by and large, have marginal advantage for production but would impose considerable burdens on it. On the other hand, many important agricultural natural resource issues (e.g. weeds, acidification) have few off-site impacts. Hence, addressing them provides little in the way of broader environmental benefits.

Successfully and equitably dealing with the social, economic and environmental problems flowing from past and current use of Australia's landscapes must involve dealing fairly and squarely with this disjunction. There will be some 'win-wins' through management that provides joint environmental and production benefits, but the underlying trade-off is substantial and cannot be ignored. The three scenarios highlight this disjunction between environmental and production natural resource management issues, but they also demonstrate possibilities for negotiating the disjunction and sharing the benefits of changed management. For example, substantial reductions in resource use could be achieved through the provision of better alternatives, in which case the "cost" of lost resource use is in fact a net gain to the farmer and the environment (Williams and Saunders 2003). These alternatives may be ideal for some

farmers; e.g. irrigators looking to cash-in their water allocations and retire, or dryland farmers feeling the effects of the cost-price squeeze. Alternatively, as illustrated in the “Brave new regions” scenario, a more direct resolution of the disjunction between production and environmental issues would be to redesign agricultural landscapes to provide both increased productivity and lower environmental impacts (Williams and Saunders 2003). While this scenario produces a clear win-win outcome, it would probably require a much greater investment to achieve than the other scenarios we describe.

Water resources

Currently large volumes of irrigation water are used to produce relatively low-value commodities. The scenarios demonstrated that, through structural change there is considerable scope to significantly increase both the total value of irrigated produce and environmental flows and river health in southern Australia. Indeed, southern Australia does not have a water constraint problem, it has a water allocation problem. Solving this problem over the coming decades is largely an institutional problem, not a physical problem.

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